CLAIMS

1. A method for cooling a material to be removed from the grate of a fluidized bed furnace, in which method the material at a high temperature is passed from the grate of the fluidized bed furnace into a separate fluidized bed cooler, the material is cooled in the fluidized bed cooler partly by fluidization air and partly by heat transfer into a cooling liquid circulation system, and the cooled material is discharged from the fluidized bed cooler, and in which method

a) a charge of material containing material to be cooled is loaded into the fluidized bed cooler,

b) during cooling, the temperature of the charge is measured,

c) the cooled charge is discharged from the fluidized bed cooler when the temperature of the charge as indicated by the temperature measurement has fallen to a predetermined limit value of temperature, and

d) steps a) - c) are repeated cyclically, characterized in that, during the loading step a), the quantity of the material accumulating in the fluidized bed cooler is measured, and the supply of material into the fluidized bed cooler is prevented when the quantity of the material in the fluidized bed cooler corresponds to a predetermined quantity of a charge to be loaded at one time.

2. A method according to claim 1, characterized in that during the loading step a), the surface level of the material accumulating in the fluidized bed cooler is measured, and when the measured surface level has reached a predetermined limit value, which corresponds to a predetermined quantity of a charge to be loaded at one time, the supply of material into the fluidized bed cooler is prevented.

3. A method according to claim 1 or 2, characterized in that during the loading step a), the fluidization air counter-pressure caused by the material is measured, and when the measured counter-pressure has reached a predetermined limit value, which corresponds to a predetermined quantity of a charge to be loaded at one time, the supply of material into the fluidized bed cooler is prevented.

4. A method according to any one of claims 1 - 3, characterized in that a supply conduit extending between the grate of the fluidized bed furnace and the fluidized bed cooler is provided, and during the loading step a) the material is allowed to flow out from the grate via the supply conduit into the fluidized bed cooler by gravitation.

5. A method according to any one of claims 1 - 4, characterized in that the fluidized bed cooler is provided with a discharge conduit for discharge of material from the fluidized bed cooler, and during the discharge step c) the material is allowed to flow out of the fluidized bed cooler via the discharge conduit by gravitation.

6. A method according to any one of claims 1 - 5, characterized in that the supply conduit is cleaned periodically at regular or irregular time intervals.

7. A method according to any one of claims 1 - 6, characterized in that the filling time required for filling the fluidized bed cooler with a material charge is determined, the measured filling time is compared to a predetermined filling time limit value, and if the measured filling time exceeds the predetermined limit value, then the supply conduit is cleaned.

8. A method according to claim 6 or 7, characterized in that the supply conduit is cleaned by blowing pressurized air through the supply conduit.

9. A method according to any one of claims 1 - 8, c h a r a c t e r i z e d in that

- the exhaustion of the fluidized bed cooler is established on the basis of a determination of surface level and/or counter-pressure after the surface level and/or counter-pressure have/has fallen to predetermined limit values,

- after it has been established that the fluidized bed cooler has become substantially exhausted, the discharge conduit is closed,

- the supply conduit is opened to load a material charge to be cooled into the fluidized bed cooler,

- the supply conduit is closed after the material charge has been loaded,

- the cooling of the material charge to the predetermined limit value of temperature is detected via a temperature measurement, and

- the discharge conduit is opened to remove the charge.

10. A method according to any one of claims 1 - 9, c h a r a c t e r i z e d in that, after the material charge has been cooled, samples are repeatedly taken from the cooled material, and the sample is analyzed to determine the current state of the bed in the fluidized bed furnace.

11. A method according to any one of claims 1 - 10, c h a r a c t e r i z e d in that the fluidized bed furnace is used as a calcining kiln for the calcination of an ore concentrate, and the material to be removed from the grate and cooled consists of coarse-grained, substantially non-fluidizable calcine material accumulated on the grate.

12. A method according to claim 11, c h a r a c t e r i z e d in that the material charge is cooled from a temperature of about 900°C - 1000°C to a temperature of about 100°C - 400°C.

13. A method according to claim 11 or 12, characterized in that the material to be cooled consists of calcine of zinc ore concentrate.

14. An apparatus for cooling a material to be removed from a first grate (2) of a fluidized bed furnace (1), said apparatus comprising

- a supply conduit (3) having an upper first end (4), which opens onto the first grate (2) to receive the material to be cooled from the grate (2) into the supply conduit (3), and a lower second end (5),

- a fluidized bed cooler (6), which comprises

-- a housing (7), into the upper part of which the second end (5) of the supply conduit (3) opens, which housing encloses an interior space for receiving the material and to which housing are connected cooling liquid tubes (8) for cooling the material in the interior space,

-- a second grate 9, which is provided with a number of through holes (10) and which second grate has been arranged to divide the interior space of the housing into a fluidized bed space (11) above the second grate, where the material to be cooled is present as a fluidized bed, and an air distribution space (12) below the second grate,

-- an air supply duct (13), which opens into the air distribution space (12) to supply air into the air distribution space and from there further through the holes (10) of the second grate (9) into the fluidized bed space (11) for fluidizing and cooling the material to be cooled, and

-- discharge conduit (14), which opens into the fluidized bed space (11) to remove cooled material from the fluidized bed space,

- a discharge valve (17) provided in the discharge conduit (14), which discharge valve in an open position allows and in a closed position prevents the

passage of material out of the fluidized bed space (11),

- a second power means (18) for opening and closing the discharge valve (17), and

- temperature measuring means (21) for producing temperature data regarding the temperature of the material in the fluidized bed space, characterized in that the apparatus comprises

- a supply valve (15) disposed at the second end (5) of the supply conduit (3), which supply valve in an open position allows and in a closed position prevents the supply of material into the fluidized bed space (11),

- a first power means (16) for opening and closing the supply valve (15),

- quantity detection means (19, 20) for producing quantity data regarding the quantity of material in the fluidized bed space (11), and

- a control device (22), which has been arranged to control the first power means (16) for opening and closing the supply valve (15) and the second power means (18) for opening and closing the discharge valve (17) on the basis of the quantity data and temperature data and predetermined limit values of quantity and temperature, so that the loading of material into the fluidized bed space of the fluidized bed cooler and its cooling and removal from the fluidized bed space take place in a charge-by-charge and cyclic manner.

15. An apparatus according to claim 14, characterized in that the supply valve (15) is a flap valve.

16. An apparatus according to claim 14 or 15, characterized in that the discharge valve (17) is a flap valve.

17. An apparatus according to any one of claims 14 - 16, characterized in that the quantity detection means comprise a surface level de-

tector (19) for determining the material surface level in the fluidized bed space (11).

18. An apparatus according to claim 15, characterized in that the surface level detector (19) is a surface level detector working on a radiometric level measurement principle and comprising a radiation source and a detector, which are mounted on the outside of the housing (7).

19. An apparatus according to any one of claims 14 - 18, characterized in that the quantity detection means comprise a pressure detector (20), which is mounted in the air supply duct (13) for measuring the counter-pressure of the fluidization air.

20. An apparatus according to any one of claims 14 - 19, characterized in that the apparatus comprises a cleaning device (23) for the cleaning of the supply conduit (3).

21. An apparatus according to claim 20, characterized in that the control device (22) comprises means arranged to determine the filling time required for the loading of the fluidized bed cooler with a material charge of a predetermined size and to compare the measured filling time to a predetermined limit value of filling time, and if the measured filling time exceeds the predetermined limit value of filling time, the control device (22) has been arranged to instruct the cleaning device (23) to clean the supply conduit.

22. An apparatus according to claim 20 or 21, characterized in that the cleaning device (23) is a pneumatic cleaning device, which has been arranged to blow pressurized air into the supply conduit (3).

23. An apparatus according to claim 22, characterized in that the cleaning device (23) comprises a frame (24); a cleaning tube (25) movably supported on the frame (24); a third power means (26)

for moving the cleaning tube, said third power means being controllable by the control device (22); and means for supplying pressurized air into the cleaning tube, the cleaning tube (25) being movable by the third power means between a cleaning position and a rest position, and in which cleaning position the end of the cleaning tube (25) is inside the second end (5) of the supply conduit (3) for blowing pressurized air into the supply conduit, and in which rest position the end (27) of the cleaning tube (25) is at a distance from the second end (5) of the supply conduit (3).

24. An apparatus according to any one of claims 14 - 23, characterized in that the apparatus comprises a sampling device (28) connected to the discharge conduit (14) for taking samples from the cooled material.

25. An apparatus according to any one of claims 14 - 24, characterized in that the fluidized bed furnace (1) is a calcining kiln for the calcination of an ore concentrate, such as zinc ore concentrate, and the material to be cooled consists of coarse-grained, substantially non-fluidizable calcine material to be removed from the grate of the calcining kiln.

26. An apparatus according to claim 25, characterized in that the fluidized bed cooler (6) has been fitted to cool the material from a temperature of about 900°C - 1000°C to a temperature of about 100°C - 400°C.